

CONTRIBUTIONS FROM THE CRYPTOGAMIC LABORATORY OF  
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A PRELIMINARY ENUMERATION OF THE  
SOROPHOREÆ.

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Presented by Roland Thaxter. Received November 9, 1901.

OWING to unavoidable delay in the publication of a monograph of the Acrasieæ and their allies which the writer has in preparation and for which figures have already been drawn, the following preliminary synopsis, which includes all the known forms and which will be supplemented as soon as possible by the more extended paper, has seemed advisable. This investigation was undertaken some years since at the suggestion of Professor Thaxter, and a majority of those species that I have myself studied have been kept under observation in pure cultures for a long period, so that the constancy of the characters distinguishing them has been definitely determined. As far as I am aware only one member of the group has been heretofore reported from America, although certain of them are very abundant in laboratory cultures. Of the European representatives several remain unknown except through the original diagnoses, which are unfortunately, in a majority of cases, meagre and unaccompanied by figures.

A comparison of the conditions presented by the individuals which constitute the so-called fructifications of these organisms indicates that the term *spore* cannot be properly applied to them in all cases. In the genera *Sappinia* and *Guttulinopsis* the individuals, even in mature fructifications, are merely slightly contracted and hardened, secreting no definite wall. At germination such resting individuals, therefore, gradually assume the form of a vegetative amœba without casting off a spore wall of any kind. In order to distinguish these bodies from true spores, such as occur in a majority of the genera, as well as from the transitory resting conditions of isolated vegetating amœbæ which were first characterized as "microcysts" by Cienkowski, the term *pseudospore* is

here employed, since it expresses with sufficient exactness the actual conditions.

It will be noted further that in characterizing the Acrasieæ as a whole, emphasis has been laid on the fact, usually overlooked in accounts of these organisms, that the vegetative stage ends before the pseudoplasmodium condition begins. The latter, therefore, is a phenomenon connected not with vegetation but with fructification, and is by no means homologous with the plasmodium of true Myxomycetes; nor is it comparable to the vegetative net-plasmodium of the Labyrinthuleæ.

I have followed Zopf, moreover, in characterizing as a "net-plasmodium" the peculiar form of association occurring in the Labyrinthuleæ, although it appears to be doubtful whether, in all cases at least, the condition thus distinguished represents a true fusion, or whether the relation is merely one of contact.

### SOROPHOREÆ Zopf.

Amœbæ of the usual irregular myxamœba form or more or less regular and spindle-shaped, never possessing a swarm spore stage, forming either a pseudoplasmodium or a net-plasmodium; resting bodies borne in sessile or stalked sori, which are either naked or imbedded in a gelatinous matrix.

### ACRASIEÆ Van Tieghem.

Saprophytic, usually coprophilous, organisms, having two definitely recurring stages, — a vegetative period, in which independent myxamœbæ crawl about by means of amœboid movements and undergo multiplication by division; and a fructifying period, in which the myxamœbæ typically aggregate into colonies called pseudoplasmodia and form either spores or pseudospores, held together by a mucus substance, and borne in stalked or sessile naked masses, or sori.

### SAPPINIACEÆ.

Myxamœbæ comparatively large, with lobose pseudopodia. The resting stage consisting either of a single encysted individual or of many individuals encysted in masses at the ends of projections of the substratum.

This group is included here only provisionally, since the amœbæ normally become encysted singly, thus forming microcysts, and do not show the characteristic phenomenon of aggregation, or colony formation. The aggregations which, it is true, often occur at the distal ends of

small projections above the surface of the substratum, are not due to any chemotactic stimulus such as must be assumed to cause the formation of true pseudoplasmodia, but, although they may perhaps suggest the possible beginnings of such conditions, are probably accidental, resulting rather from a tendency of the amœbæ to seek drier situations at the period of fructification.

### SAPPINIA Dangeard (1896).

Characters of the order.

#### *Sappinia pedata* Dangeard.

Le Botaniste, 5 Ser. p. 1-20. 5 Figs in text. 1896.

Amœbæ forming resting conditions of three kinds: "*amibes pédicellées*," in which they are transformed into a pear-shaped body without definite wall raised above the substratum by a stalk of about equal length; "*kystes pédicellés*," in which they are similarly modified but which form a definite wall about the oval body; and "*spores*," in which groups of individuals become encysted at the ends of projections from the substratum.

On dung of horse, cow, dog. France; Russia; Massachusetts; Indiana.

At least two species of this genus appear to be common on various kinds of dung in this country, but owing to the fact that Dangeard gives no measurements I have been uncertain which of them should be referred to *S. pedata*. In both forms resting bodies comparable to the aggregated "*spores*" occur, as well as "*amibes pédicellées*," although I have not as yet observed the definitely walled "*kystes*" which Dangeard appears to distinguish from them.

The larger and more frequent of the American species, which I have assumed to belong to *S. pedata*, has the following measurements: stalk of the "*amibes pédicellées*"  $30\mu$ – $125\mu$ , head  $30\mu$ – $60\mu$  long; rounded individuals ("*spores*") of the aggregations  $20\mu$ – $50\mu$  in diameter.

### GUTTULINACEÆ Zopf.

Myxamœbæ either limax-shaped, without pseudopodia, or of the ordinary form with rounded or lobose short pseudopodia. The sori, irregular in shape or spherical, sessile or stalked, consisting of either spores or pseudospores.

#### GUTTULINOPSIS nov. gen.

Myxamœbæ having lobose pseudopodia. Sori sessile or stalked, composed of pseudospores, those of the stalk usually slightly elongated.

*Guttulinopsis vulgaris* nov. sp.

Sori usually stalked, sometimes sessile, about  $150\mu$ – $500\mu$  in height  $\times$   $150\mu$ – $400\mu$  broad. Fructifications varying in color from whitish to dirty yellowish according to the character of the substratum and the dryness of the sorus. Pseudospores usually irregularly spherical, about  $4\mu$ – $8\mu$  in diameter.

On dung of horse, cow, pig, mouse, etc. Cambridge, Mass; Alabama; Indiana; Maine; Porto Rico.

This form, which has conspicuous fructifications so large that they may be readily seen with the naked eye, has been met with very frequently on fresh cultures of various kinds of dung. Although *Guttulina aurea* Van Tieghem may prove to be identical with the above species, the fact that, according to the original description, it possesses resting bodies which are characterized as "spores," having a golden yellow color, renders it improbable that the two forms are the same.

*Guttulinopsis stipitata* nov. sp.

Sori yellowish white, long stalked, the stalk composed of individuals similar to those of the head. Sorus about 1 mm.–1.2 mm. high; the stalk about  $800\mu$  long, the head  $250\mu$  in diameter. Pseudospores spherical,  $3\mu$ – $5\mu$  in diameter.

On dung of dog. New Haven, Conn.

This species, the largest representative of the genus, has been met with but once, and is founded on a mounted specimen and dried material collected at New Haven some years ago by Dr. Thaxter.

*Guttulinopsis clavata* nov. sp.

Sori yellowish white when young, comparatively long-stalked, the stalk composed of a column of slightly elongated individuals surrounded by mucus. The stalk-cells held within the peripheral mucus adhere together after the deliquescence of the pseudospores of the head, forming at the apex a rounded or conical columella of elongated adherent cells. Sorus about  $400\mu$ – $800\mu$  in height, the stalk about  $170\mu$ – $250\mu$  long, the head  $100\mu$ – $400\mu$  in diameter. Pseudospores of the head somewhat broadly oval,  $3\mu$ – $4\mu \times 6\mu$ – $7\mu$ , or spherical, then  $4\mu$ – $5\mu$  in diameter; those of the stalk about  $3\mu$ – $5\mu \times 7\mu$ – $10\mu$ .

On dung of dog. Cambridge, Mass.; Indiana.

This distinct species is frequently met with in fresh cultures of the dung on which it has its habitat. The base of the stalk is often imbedded

in an abundant mucus, which is especially noticeable when it swells after being placed in water.

**GUTTULINA** Cienkowsky (1873).

*Myxamœbæ* limax-shaped, without pseudopodia. Sori irregular in shape or spherical, sessile or stalked, composed of spores which have a definite protective cell-wall. The cells of the stalked forms somewhat differentiated in shape.

**Guttulina rosea** Cienkowsky.

Trans. 4th Session of Russ. Nat. at Kazan, 1873.

“Sori short-stalked and rose-colored; head  $700\mu$  long, supported upon a stalk of about equal length. Spores of the head spherical; those of the stalk closely laid and wedge-shaped.”

On dead wood. Russia.

Known only from the original description above quoted.

**Guttulina protea** Fayod.

(*Copromyxa protea* Zopf.)

Bot. Zeit., 11, p. 167-177. 1 Plate. 1883.

Sori 1-3mm. high, sessile or short-stalked, of somewhat irregular form, yellowish white, with crystalline lustre. Spores  $9\mu \times 14\mu$ ; hyaline, colorless or slightly yellowish, more or less oblong or oval, bean-shaped, or almost triangular in outline.

On dung of horse and cow. Germany.

This form, which is known only from Fayod's original description, is retained under its original name, notwithstanding the fact that it has been separated by Zopf under the name *Copromyxa* on the ground that the “*myxamœbæ* undergo no differentiation into stalk and head cells, whereas in Cienkowsky's form, there is a slight differentiation.” The fact that certain species of *Guttulinopsis* show both stalked and sessile forms in the same culture diminishes the importance of the stalk as a character of generic value and justifies the resumption of the original name given by Fayod.

**Guttulina aurea** Van Tieghem.

Bull. de la Soc. Bot. de France, XXVII. p. 317. 1880.

“*Guttulina aurea* has its fruit pedicelled and resembles closely *G. rosea*, but differs in color. The spores spherical,  $4\mu$ - $6\mu$ , golden-yellow. Upon dung of horse.” France.

*Guttulina sessilis* Van Tieghem.

Bull. de la Soc. Bot. de France, XXVII. p. 317. 1880.

"Fruit sessile; a simple droplet of pure white, resting directly on the substratum. Spores oval, colorless, aggregated in a sphere and cemented, as in the preceding species, by a gelatinous substance;  $4\mu \times 8\mu$ . On the integument of beans in a state of decay." France.

*Guttulina aurea* and *G. sessilis* are known only from the original descriptions above quoted.

## DICTYOSTELIACEÆ Rostafinski.

Myxamœbæ possessing slender elongated pseudopodia. Sori consisting of spherical masses of spores or of a chain of spores; stalked, the stalks composed of distinct parenchyma-like cells with cellulose walls.

## ACRASIS Van Tieghem (1880).

Spores concatenate, terminating an erect simple filament, consisting of a single row of superposed cells.

*Acrasis granulata* Van Tieghem.

Bull. de la Soc. Bot. de France, XXVII. p. 317. 1880.

Spores spherical, with a slightly roughened or granular wall, having a cuticularized external portion of deep violet color;  $10\mu$ – $15\mu$  in diameter, often unequal in the same chain, the chain varying much in the number of component spores and cells.

On a culture of beer yeast. France.

Known only from the original description.

## DICTYOSTELIUM Brefeld (1869).

Sori stalked; the stalk simple or only occasionally bearing irregularly disposed branches; luxuriant fructifications frequently gregarious. Sori spherical, or subglobose.

*Dictyostelium mucoroides* Brefeld.

(Ceratopodium elegans Sorokin.)

Abh. d. Senck. Nat. Ges., VII. p. 85–108. Pl. I–III. 1869.

Sorus and stalk white, or when old, yellowish; the fructifications varying in height from 2–3 mm. to 1 cm. or more. Spores oval or elongated ellipsoid,  $2.4\mu$ – $3\mu \times 4\mu$ – $6\mu$ .



On the dung of various animals, such as horse, rabbit, dog, guinea pig, grouse, etc. Also found on cultures of yeast, paper, fleshy fungi, etc., in a state of decomposition. Germany, Russia, common in America.

This very common species is extremely variable in the size of its spores and fructifications. The limits of the spore measurements as given by Brefeld in his original description have been therefore somewhat increased.

**Dictyostelium sphærocephalum** (Oud.) Sacc. and March.

(*Hyalostilbum sphærocephalum* Oudemans.)

Aanw. Myc. Nederl., IX.-X. p. 39. Pl. IV. 1885.

Sorus white; when old, yellowish or greenish-white. Stalk frequently very long and luxuriant, varying from 2 mm. to 1.5 cm. Spores oval, rarely spherical, or sub-inequilateral,  $3\mu-5\mu \times 5\mu-10\mu$ .

Dung of mouse, (common), rat, bird, toad, deer, turtle, muskrat, etc. Belgium; Cambridge and Boston, Mass.; New Hampshire; Florida; Pennsylvania; Liberia.

In the above description the limits of the measurements of spores and of the length of stalks are greater than those given by Marchal, by whom the maximum length of the spore is stated as  $8\mu$  and that of the stalk as 5mm. The measurements of the fructifications are certainly more variable than indicated by Oudemans. This species was founded by Marchal from the fact that the spores differed in size from those of *Dictyostelium mucoroides*, which he states to be only about one-half as large. As will be seen by the measurements given above, this difference is by no means as great as indicated; and, although the present arrangement is retained for the present, it may prove desirable to unite these two variable species.

**Dictyostelium roseum** Van Tieghem.

Bull. de la Soc. Bot. de France, XXVII. p. 317. 1880.

"Spore mass spherical, of a bright rose color. Spores elongated oval,  $4\mu \times 8\mu$ . On the dung of various animals; especially on rabbit dung, in company with *Pilobolus microsporus*." France.

**Dictyostelium lacteum** Van Tieghem.

Bull. de la Soc. Bot. de France, XXVII. p. 317. 1880.

"The mass of spores forms a milk-white drop at the summit of a stalk which I have always seen composed of a single row of cells. Spores

colorless, spherical, very small,  $2\mu$ - $3\mu$  in diameter. This form has been met with several times on decaying agarics." France.

Neither of the two preceding forms have been found in American cultures, hence the writer can add nothing to our knowledge concerning them.

*Dictyostelium brevicaule* nov. sp.

Sorus white; stalks 1-3 mm. high. Spores oval,  $3\mu$ - $4\mu \times 4\mu$ - $7\mu$  or rarely spherical and  $3\mu$ - $4\mu$  in diameter.

Dung of sheep and goat. Cambridge, Mass.

A small, erect fructification, quite constant in the possession of a short rather rigid stalk bearing a sorus of comparatively large size and very different in aspect from the long, luxuriant, frequently flexuous, fructifications of *D. mucoroides* and *D. spherocephalum*. Throughout the four years that this species has been kept growing in laboratory cultures, it has retained its original distinct characters.

*Dictyostelium purpureum* nov. sp.

Sorus and stalk purplish or violet; when mature, almost black. Spores oval, rarely somewhat inequilateral,  $3\mu$ - $5\mu \times 5\mu$ - $8\mu$ .

Dung of mouse, toad, cow, horse, sheep, muskrat. Cambridge, Mass.; Indiana; Florida.

This distinct species, well-marked by its color, was collected in August, 1897, in Crawfordsville, Indiana, on mouse dung cultures, and in October of the same year by Dr. Thaxter in Eustis, Florida, on toad dung. Both forms have been cultivated ever since in the laboratory, with no particular precautions as to the dissemination of the spores, and it is not impossible that the fructifications which appeared at Cambridge on sub-strata other than the two just mentioned represent laboratory escapes.

*Dictyostelium aureum* nov. sp.

Mature sori light to golden yellow, 1.5mm.-4mm. high. Spores oval, or frequently inequilateral,  $2.5\mu$ - $3\mu \times 5\mu$ - $8\mu$ .

Mouse dung from Porto Rico.

This species, communicated by Dr. Thaxter, is quite well defined through the color of its fructifications, but especially so by its myxamœbæ and its manner of growth. It matures very slowly on a horse dung decoction or on other media especially favorable for the rapid development of the common species; while the myxamœbæ, instead of possessing the



usual form with elongated, sharp pseudopodia, are in general irregularly lobed and nodulated, even when growing under normal conditions. Such irregular shapes are similar to those assumed by the myxamœbæ of other species when they are growing under such abnormal conditions as are furnished by an insufficient water supply.

### POLYSPHONDYLIUM Brefeld (1884).

Sori spherical, borne terminally on primary and secondary stalks, the latter branching in whorls from the main axis; the fructification occasionally simple as in *Dictyostelium*. Whorls varying in number from 1-10, and the number of branches in each whorl from 1-6.

#### *Polysphondylium violaceum* Brefeld.

Schimmelpilze, VI. p. 1-34. Pl. I, II. 1884.

Sori and stalks purplish or dark violet, varying in height from about  $\frac{1}{2}$  cm.-2 cm.; sori about  $50\mu$ - $300\mu$  in diameter. Spores elongated oval,  $2.5\mu$ - $5\mu \times 6\mu$ - $8\mu$ .

On dung of horse, bird, sheep, toad, muskrat. Italy, Maine, New Hampshire, Massachusetts, Florida.

The limits of spore measurements as given by Brefeld have been increased here as in other instances. The form growing on bird dung, brought by Prof. F. O. Grover from Center Ossipee, N. H., and the Massachusetts form on the dung of muskrat, seem to correspond very closely to the type description. The spores of the Maine and Florida forms are somewhat smaller, while the general aspect of the fructifications is different in that they are more delicate and less luxuriant and the sori have a less diameter than those of the type. These differences, however, seem hardly more than varietal.

#### *Polysphondylium pallidum* nov. sp.

Sori and stalks white, the sori about  $50\mu$ - $80\mu$  in diameter. Spores oval,  $2.5\mu$ - $3\mu \times 5\mu$ - $6.5\mu$ , or occasionally spherical, about  $7\mu$ - $8\mu$  in diameter.

On dung of ass, rabbit, muskrat. Liberia, Africa; Arlington and Stony Brook, Mass.

This delicate species is well characterized by the small size of its sori. In an interesting specimen, found by Mr. A. F. Blakeslee on muskrat dung, luxuriant fructifications showed that some of the branches themselves bore several whorls of branchlets. That this doubly verticillate

character was not constant, however, was proved by growing the form on a sterilized nutrient medium, on which the fructifications showed simply the normal method of branching.

**Polysphondylium album** nov. sp.

Sori and stalks white, the sori  $100\mu$  to  $200\mu$  in diameter. Spores oval,  $2.5\mu-3\mu \times 4\mu-5.6\mu$ .

On dung of toad from Eustis, Florida.

Although the two forms above described have some features in common, their gross characters are such as to justify their being placed in separate species. The sori of *P. album* are not only larger but are usually more numerous in a whorl, hence its fructifications are more conspicuous; moreover, the stalks of this species are rather constantly weak at the base, so that the fructifications lie close to the substratum in a characteristic fashion.

**CÆNONIA** Van Tieghem (1884).

Sorus globular, borne at the summit of a stalk which is dilated into a sort of cupule, in which the sorus is supported.

**Cænonia denticulata** Van Tieghem.

Bull. de la Soc. Bot. de France, XXXI. p. 303-306. 1884.

Sorus yellowish; stalk colorless, 2-3 mm. high, having a dilated base and expanding at the summit into a cupule which is finely toothed at its edges; each peripheral cell of the stalk bearing a tooth or papilla on its exposed side. Spores  $6\mu-8\mu$  in diameter, with yellowish cell walls.

On decaying beans. France.

This remarkable form, so far as I am aware, has not been met with since it was originally described by Van Tieghem.

**LABYRINTHULÆ** Cienkowski.

Organisms having two definitely recurring stages, — a vegetative stage in which spindle-shaped or rarely spherical amœbæ, bearing usually bipolar filiform pseudopodia singly or in tufts, may be either isolated or combined by the union of the pseudopodia into colonies forming net-plasmodia; and a fructifying stage, in which aggregations of individuals, comparable to pseudoplasmodia, form spores borne in stalked or sessile sori.

Saprophytic or parasitic organisms living on dung, or on algæ in fresh or salt water.

**LABYRINTHULA** Cienkowsky (1867).

Amœbæ spindle-shaped, colorless, or colored by means of yellow fat bodies. Spores borne in formless masses, producing one to four amœbæ at germination.

The species of this genus have thus far been observed only by the authors cited.

**Labyrinthula vitellina** Cienkowsky.

Archiv. f. mikros. Anat., III. p. 274, Taf. 15-17. 1867.

Amœbæ containing orange-red coloring matter, which turns blue with iodine. Spores oval or spherical,  $12\mu$  in diameter, producing four amœbæ at germination.

Living on sea-weeds growing on piles in Odessa harbor, Russia.

**Labyrinthula macrocystis** Cienk.

Archiv. f. mikros. Anat., III. p. 274, Taf. 15-17. 1867.

Colorless or feebly yellowish. Spores spindle-shaped,  $18\mu$ - $25\mu$  long, imbedded in a hyaline substance; the contents producing four amœbæ at germination.

Living on algæ growing on piles at a higher elevation than *L. vitellina*, only submerged by the surf. Russia.

**Labyrinthula Cienkowskii** Zopf.

Beiträge zur Phys. u. Morph. niederer Organismen, II. p. 36-48, Taf. IV, V. 1892.

Sori colorless, naked. Spores at germination producing only one or at most two amœbæ.

Living in fresh water, parasitic on *Vaucheria*. Germany.

**DIPLOPHRYS** Barker (1868).

Amœbæ spindle-shaped or nearly spherical, with yellowish oil globules. Fructification (in *D. stercorea*) a definite stalked or sessile sorus.

**Diplophrys Archeri** Barker.

Quart. Jour. Mic. Sci., VII. p. 123. 1868.

Individuals nearly spherical or broadly elliptical,  $4\mu$ - $5\mu$  in diameter, bearing at almost opposite poles a tuft of filiform pseudopodia; the pro-

toplasm containing an oil-like refractive globule of an orange or amber color. Fructification unknown.

Living in fresh water. Ireland, Germany, Pennsylvania and New Jersey (Leidy).

In this provisional arrangement, I have followed Cienkowsky in referring this species to the Labyrinthuleæ, although I regard it as improbable whether *Diplophrys Archeri* and *D. stercorea* should be included in the same genus. The aggregations of the vegetating amœbæ of *D. Archeri* seem to be an association of the young in groups, the colonies being formed by successive division of the individuals; and there is nothing definite known concerning a resting stage.

***Diplophrys stercorea* Cienkowsky.**

Archiv. f. mikr. Anat., Bd. XII. p. 44. Pl. VIII. 1876.

Individuals lens- or spindle-shaped, about  $4\mu$ – $6\mu$  long, bearing at both ends several pseudopodia, almost bilaterally symmetrical. In the interior a nucleus, one or two contractile vacuoles and a yellow pigment body. Both the isolated and united individuals of the net-plasmodium finally becoming aggregated to form without change of shape pseudospores borne in sori, which are usually stalked, sometimes sessile.

On dung of horse, cow and porcupine. Russia; Cambridge, Mass.; Intervale, New Hampshire.

This species has been met with twice in American cultures, and so far as I am aware, with the exception of *D. Archeri*, is the only representative of the Labyrinthuleæ which has been found in this country.

A form, which is probably the resting condition of *Chlamydomyxa labyrinthuloides* Archer, has been found growing in the cells of sphagnum, at Kittery, Maine, by Professor Thaxter. As Archer and others have pointed out, however, it is very doubtful whether this peculiar organism should be included in the Labyrinthuleæ.